UNIT 4 CREATIVITY AND PROBLEM SOLVING

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4.0 INTRODUCTION

Human being is exceptionally blessed with the higher level thinking abilities of creativity and problem solving. Such activities require use of already stored information along with the information concurrently received from the environment. A thorough account of these multi-step processes will be presented in this unit. First of all, we will discuss meaning, aspects and stages of creativity. This will be followed by a description of measurement of creativity and its relationship with intelligence. We will also discuss meaning, stages and strategies of problem solving. Finally, factors affecting problem solving will be discussed.

4.1 OBJECTIVES

After reading this unit, you will be able to:

- Explain meaning, aspects and stages of creativity;
- Describe the tests to measure creativity and relate it with intelligence;
- Explain meaning, stages and strategies of problem solving; and
- Analyse the factors affecting problem solving.

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4.2 CREATIVITY

The most advanced thought process, creativity, involves production of uncommon and novel ideas that are highly relevant to the situation. Creativity is defined as something different from intelligence and as a parallel construct to intelligence, but it differs from intelligence in that it is not restricted to cognitive or intellectual functioning or behaviour. Instead, it is concerned with a complex mix of motivational conditions, personality factors, environmental conditions, chance factors, and even products (Michalko, 1998).

4.2.1 Meaning and Aspects of Creativity

Creativity is a goal directed thinking which is unusual, novel and useful. Many of such creative thinking become so important that they influence the whole human civilisation and are called as historical creativity. The Mona Lisa, the laws of thermodynamics, the laws of motion, the theory of relativity are some of the ideas that were never thought before and changed the human civilisation altogether in a great way in their respective spheres of life. Although we can accept its existence and importance, it has been a highly difficult task for the researchers to define creativity.

Newell, Shaw and Simon (1963) have explained the nature of creativity on the basis of following four criteria:

a) Novelty and usefulness

b) Rejects previously accepted ideas

c) Requires intense motivation and persistence

d) Results from organising the unclear situation in a coherent, clear and new way.

Sternberg (2006) reports five commonalities in the research of creativity. These are:

1) Creativity involves thinking that aims at producing ideas or products that are relatively novel and that are, in some respect, compelling.

2) Creativity has some domain-specific and domain-general elements in the sense that it needs some specific knowledge, but there are certain elements of creativity that cut across different domains.

3) Creativity is measureable, at least to some extent.

4) Creativity can be developed and promoted.

5) Creativity is not highly rewarded in practice, as it is supposed to be in theory.

Sternberg and Lubart (1999) define creativity as the ability to produce work that is both novel (i.e. original, unexpected) and appropriate (i.e. useful concerning tasks constrains).

Runco (2007) categorised these definitions of creativity as involving the creation of something new and useful and calls them as "products definitions" of creativity. However, he thought that creative thinking did not essentially require tangible creative products; rather the process should be more focused in defining creativity.

Studies in cognitive psychology have tried to understand the process of creative thinking. These researches assumed that creativity is just extraordinary results of ordinary processes (Smith, Ward & Finke 1995). The process of creativity is thought to have following four characteristics:

1) It is imaginative involving imagination, since it is the process of generating something original.

2) It is purposeful, that is, creativity is imagination put into action towards an end.

3) It produces something original in relation to one's own previous work, to their peer group or to anyone's previous output in a particular field.

4) It has value in respect to the objective it was applied for. Creativity involves not only the generation of ideas, but also evaluation of them, and deciding which one is the most adequate one.

Beghetto and Kaufman (2007) conceptualised creativity in three different ways. They defined creativity as novel and personally meaningful interpretation of experiences, actions, and events. However, the novelty and meaningfulness of these interpretations need not require to be original or (even meaningful) to others. Indeed, the judgment of novelty and meaningfulness that constitutes creativity is an intrapersonal judgment. This intrapersonal judgment is what distinguishes creativity from other forms of creative expressions.

There are two types of creativeity (i) little-c (or everyday) creativity and (ii) Big-C (or eminent) creativity. The latter two forms of creativity rely on interpersonal and historical judgments of novelty, appropriateness, and lasting impact.

4.2.2 Investment and Confluence Theory of Creativity

Sternberg (2006) has proposed investment and confluence theory to understand creativity. According to the investment theory, creativity requires a confluence of six distinct but interrelated resources: intellectual abilities, knowledge, styles of thinking, personality, motivation, and environment. Although levels of these resources are sources of individual differences, often the decision to use a resource is a more important source of individual differences.

Intellectual skills: Three intellectual skills are particularly important: (a) the synthetic skill to see problems in new ways and to escape the bounds of conventional thinking, (b) the analytic skill to recognise which of one's ideas are worth pursuing and which are not, and (c) the practical–contextual skill to know how to persuade others of—to sell other people on—the value of one's ideas. The confluence of these three skills is also important. Analytic skills used in the absence of the other two skills results in powerful critical, but not creative, thinking. Synthetic skill used in the absence of the other two skills results in new ideas that are not subjected to the scrutiny required to improve them and make them work. Practical–contextual skill in the absence of the other two skills may result in societal acceptance of ideas not because the ideas are good, but rather, because the ideas have been well and powerfully presented.

Knowledge: On the one hand, one needs to know enough about a field to move it forward. One cannot move beyond where a field is if one does not know where it is. On the other hand, knowledge about a field can result in a closed and

entrenched perspective, resulting in a person's not moving beyond the way in which he or she has seen problems in the past. Knowledge thus can help, or it can hinder creativity.

Thinking styles: Thinking styles are preferred ways of using one's skills. In essence, they are decisions about how to deploy the skills available to a person. With regard to thinking styles, a legislative style is particularly important for creativity, that is, a preference for thinking and a decision to think in new ways. This preference needs to be distinguished from the ability to think creatively: Someone may like to think along new lines, but not think well, or vice versa. It also helps to become a major creative thinker, if one is able to think globally as well as locally, distinguishing the forest from the trees and thereby recognising which questions are important and which ones are not.

Personality: Numerous research investigations have supported the importance of certain personality attributes for creative functioning. These attributes include, but are not limited to, willingness to overcome obstacles, willingness to take sensible risks, willingness to tolerate ambiguity, and self-efficacy. In particular, buying low and selling high typically means defying the crowd, so that one has to be willing to stand up to conventions if one wants to think and act in creative ways. Often creative people seek opposition; that is, they decide to think in ways that countervail how others think. Note that none of the attributes of creative thinking is fixed. One can decide to overcome obstacles, take sensible risks, and so forth.

Motivation: Intrinsic, task-focused motivation is also essential to creativity. The research of Amabile (1983) and others has shown the importance of such motivation for creative work and has suggested that people rarely do truly creative work in an area unless they really love what they are doing and focus on the work rather than the potential rewards. Motivation is not something inherent in a person: One decides to be motivated by one thing or another. Often, people who need to work in a certain area that does not particularly interest them will decide that, given the need to work in that area, they had better find a way to make it interest them. They will then look for some angle on the work they need to do that makes this work appeal to rather than bore them.

Environment: Finally, one needs an environment that is supportive and rewarding of creative ideas. One could have all of the internal resources needed to think creatively, but without some environmental support (such as a forum for proposing those ideas), the creativity that a person has within him or her might never be displayed.

Confluence: Concerning the confluence of these six components, creativity is hypothesized to involve more than a simple sum of a person's level on each component. First, there may be thresholds for some components (e.g., knowledge) below which creativity is not possible regardless of the levels on other components. Second, partial compensation may occur in which strength on one component (e.g., motivation) counteracts a weakness on another component (e.g., environment). Third, interactions may occur between components, such as intelligence and motivation, in which high levels on both components could multiplicatively enhance creativity.

4.2.3 Aspects of Creativity

Guilford (1986) considered creative thinking as involving divergent thinking, which emphasises fluency, flexibility, originality, and elaboration. Guilford, however, noted that creative thinking is not the same as divergent thinking, because creativity requires sensitivity to problems as well as redefinition abilities, which include transformations of thought, reinterpretations, and freedom from functional fixedness in driving unique solutions. In order to develop Torrance Tests of Creative Thinking (TTCT) and in its further revisions, Torrance (1966, 1974) has explained six components of creativity. He has described these aspects of creativity in terms of their mode of measurement. These aspects of creativity are:

1) *Fluency:* The number of relevant ideas; shows an ability to produce a number of figural images.

2) *Flexibility:* Flexibility is the individual's ability to produce not only a large number of responses, ideas or solutions to a problem, but also a variety of responses, ideas or solutions to a problem.

3) *Originality:* The number of statistically infrequent ideas; shows an ability to produce uncommon or unique responses.

4) *Elaboration:* The number of added ideas; demonstrates the subject's ability to develop and elaborate on ideas.

5) *Abstractness of Titles:* The degree beyond labeling; based on the idea that creativity requires an abstraction of thought. It measures the degree a title moves beyond concrete labeling of the pictures drawn.

6) *Resistance to Premature Closure:* The degree of psychological openness; based on the belief that creative behaviour requires a person to consider a variety of information when processing information and to keep an "open mind."

Self Assessment Questions

1) Define the process of creativity.

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2) Describe that how different psychologists differ in understanding creativity.

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3) Explain that how Investment and Confluence Theory of approaches creativity.

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4) Give an account of aspects of creative thinking.

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4.2.4 Stages of Creativity

The history of research on stages of creativity began with Graham Wallas (1926) who suggested that creative thinking follows four successive steps:

Stage of preparation: The subject begins to gather information about the problem to be solved and attempts some solutions. This stage is characterised by a state of trial-and-error in learning. Therefore, the subject is advised to learn as much as possible about the problem area. In preparation the thinker begins recalling personal experiences and investigating in all different directions to gather information about the problem to be solved. The object of defining the focus question of interest is to list all concepts associated with the focus question. Since the goal from this procedure is to generate the largest possible list, the thinker should not worry about redundancy, relative importance, or relationships at this point.

Stage of incubation: In the second stage the solution exists but is not clear. The subject must not intentionally work on the problem. Instead it is allowed to sink into the unconscious. In this stage the solution exists but is not clear. Therefore, the thinker must not intentionally work on the problem. Instead, he/she should be allowed to sink into the unconscious and the thinker is advised to relax and reflect on his/her focus question which might lead him/her to modification of the focus question.

Stage of illumination: In the third stage the subject suddenly experiences insight into the problem when a new solution, idea, or relationship emerges. In other words, the subject attempts to reformulate his/her ideas or to formulate new ones. The subject is more active and more conscious work is needed in this stage. In the stage of illumination the thinker experiences insight into the problem when a new solution, idea, or relationship emerges. Thus, he/she attempts to reformulate his/her ideas or to formulate new ones.

Stage of verification: Finally, the subject tries and checks the solution. In this stage some modification may also occur to ideas reached in the previous stages. In the stage of verification the thinker tests, tries and checks the solution he/she created. Since this stage is the final one, the thinker may well make some modification to his/her ideas which he/she reached in the previous stages. In this stage thinker should rework the structure of his/her map to represent his/her collective understanding of the interrelationships and connections among groupings, which may include adding, subtracting, or changing super-ordinate concepts, thus, he/she may need to review his/her concept map as he/she gains new knowledge or new insights.

In some situations, the above stages may appear in a different order, or combined into two or three stages. They also do not occur regularly. For example, sometimes the subject's knowledge of the problem area allows him/her to pass over the first stage (preparation) and move on to the next stage (incubation) or even to the third stage.

4.2.5 Creativity and Intelligence

In one extreme opinion, creativity and intelligence are regarded as totally independent of each other. Intelligence is not supposed to influence creativity. Creativity is viewed as a mental operation accessible to everyone. It is supposedly dependent on domain-specific knowledge (i.e. the amount of exposure to and expertise in a given field) and deliberate practice.

This position denies not only the influence of intelligence, but of any individual difference beyond knowledge and motivational factors, on creativity.

A high IQ has proven as insufficient for creativity ever since Terman's (1925) famous longitudinal study of 1528 highly gifted children, which had a mean IQ of 151. While most of these children achieved remarkable occupational success in later life, none of them showed a noteworthy sign of creativity. Most of the studies concerning the association between psychometric intelligence and creativity yielded only a weak relationship. For example, Torrance (1977) reported that the median of 178 correlation coefficients between IQ and the TTCT was only .20. Also, factor analyses of IQ and creativity tests yielded separate factors.

However, a creative person's IQ has been demonstrated to be at least a standard deviation above the mean, often more. Guilford (1967) suggested a hypothesis that a minimal level of IQ, often arbitrary set to 120, should be necessary, but not sufficient for creativity. Creative achievement was thought to be impossible below this threshold. Guilford also proposed that scatter plots of IQ and creativity should show a triangular pattern (which gave Guilford's claim sometimes the name 'triangularity hypothesis') with no data points in the low IQ/high creativity quadrant. This threshold view of creativity is so plausible that it is widely accepted, though empirical test are scarce and more likely to show a disconfirming tendency.

Hayes (1989) proposed an alternative 'certification hypothesis', which doubted intrinsic links between creativity and intelligence. Instead, it stated that most possibilities to display a recognisable level of creativity, like occupations in architecture or science, simply require a high level of formal education. Since academic performance is correlated with IQ, society simply denies creative individuals of low IQ the chance to express their talent adequately.

4.2.6 Measurement of Creativity

Houtz and Krug (1995) provide a review of several tests developed for the assessment of creativity. The review reveals that most of the tests of creativity intend to measure divergent thinking. Within the category of divergent thinking, Houtz and Krug (1995) present the Torrance Test of Creative Thinking (TTCT) (Torrance 1966), The Wallach and Kogan Tests, The Guilford Battery.

The most widely used test on creativity is the *Torrance Test of Creative Thinking* (TTCT). It is also the one that has the most extended research on their reliability and validity (Kim 2006). This test has been translated into more than 30 languages and it is used in different places as a tool to assess creative potential. It is based on Guilford's Structure of the Intellect (SOI) battery that included some measures of divergent thinking. Thus, it measures creativity through divergent thinking.

The TTCT was developed in 1966, and it has been re-normed four times: 1974, 1984, 1990 and 1998. There are two forms, TTCT-Verbal and Figural with two parallel tests (form A and B). Each test is expected to measure

1) Fluency: The number of ideas: Total number of relevant responses.
2) Originality: The rarity of ideas: Number of statistically infrequent ideas. The score is 0 if the idea is common, and 1 if it is unique.
3) Elaboration: The number of added ideas.
4) Flexibility: Number of categories of the relevant responses.

In 1990 Torrance deleted the flexibility scale, since it correlated highly with fluency and added two measures of creative potential, viz., (i) abstractness of titles and (ii) resistance to premature closure.

While (i) abstractness of title refers to the degree a title moves beyond concrete labelling of pictures drawn, (ii) resistance to premature closure pertains to measure the degree of psychological openness. The test can be administered in around 30 minutes, but the process of scoring requires some training and specific country norms.

The 1998 manual provides norms for the United States and includes both grade related and age related norms. Thus, there is some country specificity in the measurement of creativity. Kim (2006) reported some normative measures in other countries. These norms have usually been developed for research activities.

Criticisms against TTCT

There are 4 main criticisms against this test and these are:

1) The response set might influence the results. Thus, different order in the presentation of the items leads to different results.
2) Creativity tests administered under different conditions lead to differences in performance.
3) Raters of the TTCT might differ considerably in their scores to a similar person.
4) The structure of the test itself is inadequate.

Self Assessment Questions

1) Explain the stages of creativity.

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2) Describe how creativity is related to intelligence.

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3) Explain the threshold hypothesis.

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4) Give an account of measurement of creativity.

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4.3 PROBLEM SOLVING

The thought process involved in a person's effort to remove obstacles in the way to achieve the goal state is called problem solving. Such a process is involved in critical thinking in taking many important decisions of life as well as in solving simple routine problems. Psychological researches have uncovered many aspects of problem solving behaviour which will be discussed in the following sections.

4.3.1 Terms Related to Problem Solving

Original or initial state: Problem solving begins with a certain original state called the initial state of a problem.

Goal or end state: This is what will be reached if the problem is solved. The goal state is what is desired by the person. The goal state has some properties defined by the person.

The person concerned who is with the initial state of the problem and wants to reach the goal, puts in efforts to reach that goal. There may be obstacles to reach the goal which will have to be overcome.

Person / operator: This refers to the person who is in the initial state and strives to achieve the coal or end state through application of certain skills and techniques which would facilitate overcoming the obstacle and reaching the goal state. Operator manipulates the elements involved in the problem internally with the help of some global or personal symbols or visual images.

Problem space: Initial state, goal state and operator combine to form the problem space. The problem space includes a number of elements in it that are required to be organised in a particular manner. A successful understanding of the problem space would require: coherence, correspondence and relationship to background knowledge. Coherent understanding of the problem space refers to connecting the elements in a meaningful manner. A successful understanding also requires a close correspondence between the internal representation and the elements of the problem space. None of the elements should be left unmatched and also none of them should be mismatched. Therefore, proper matched connections should be made among all the elements.

Rules: These refer to rules that exist in converting the problem state into a goal state.

More specifically it may be stated that Problem solving behaviour begins with an obstacle or difference between *original* or *initial state* and *goal* or *end state*. The goal is desired by the person/s or *operator/s* in the situation and has some properties defined by the operator.., defined by some *rules*, to convert the problem state into the goal state.

An Example of Problem Solving: A classical example of problem solving behaviour may be explained with the help of Kohler's experiments with a chimpanzee. In one experiment, Kohler (1927) put a hungry chimpanzee (operator) in a closed cage with bananas hanging from the roof (goal state) and three boxes on the floor. It should be noted that the chimpanzee can come closer to the bananas only by putting all the three boxes together in vertical manner (rule). In Kohler's experiment, after a series of irrelevant behaviours the chimpanzee suddenly solved the problem and reached to the bananas. Such sudden solutions of the problem resulted from internal representation and understanding of the problem which was continuously going on in the chimpanzee's unconscious and is termed as insight by Kohler and other *Gestalt* psychologists.

4.3.2 Typologies of Problems

Well-defined and Ill-defined Problems

A problem is well-defined if there is a definable initial state and a goal state, definite number of operators well identified and clear and explicit rules and sub-goals to convert the initial state into the goal state.

The problem faced by the chimpanzee in the Kohler's experiment is a good example of a welldefined problem.

However an ill-defined problem is in which one or all of the elements of the problem space (initial state, goal state, operators and rules) are not clearly defined. Creation of a painting is a unique example of ill-defined problems.

Problems of Inducing Structure:

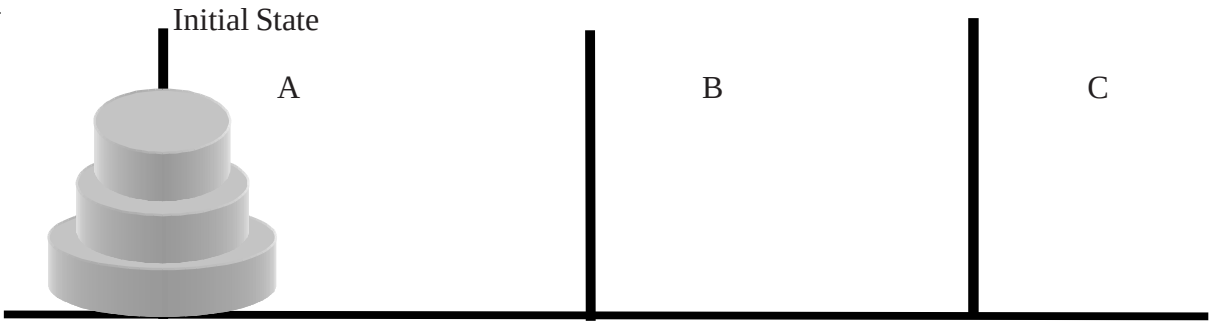
Problems of inducing structure require determining relationship among several elements of the problem. For example take the analogy problem in which the operator is required to find a structure in some elements with clearly defined rules. Example of structured elements are "bird to sky as fish is to water".

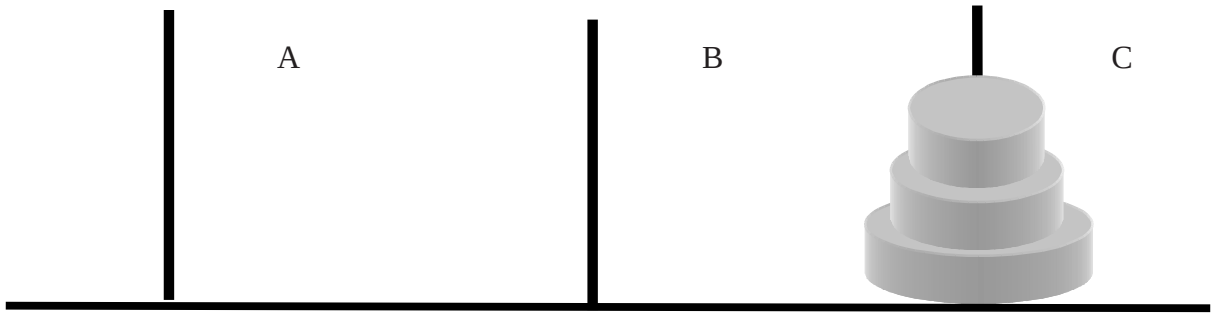
Solving analogy problems requires three types of cognitive skills:

1) Process of attribute discovery
2) Process of encoding
3) Process of comparing encoded attributes and evaluating attribute based structure among the elements.

Problems of Transformation

Problems of transformation require finding a sequence of operations to transform the initial state into the goal state. A classic example of such a problem is Tower of Hanoi. A modified version of the problem is illustrated in the figure given below:





At the initial state, there are three discs placed in peg A. Operator is required to move all the three discs on to the peg C. Rules of the game are that only one and the top disc can be moved at a time and the bigger disc cannot be placed over the smaller one.

Problems of Arrangement:

Problems of arrangement requires the operator to rearrange the elements of the problem according to some criterion. In some of such problems the arrangement criterion is predefined, while in others the operator himself is required to discover it. An example of such problems is anagram in which order of letters of a word changed and the operator is asked to rearrange their sequence to form a meaningful word.

The cognitive skill needed to solve an anagram is constructive search by which operator systematically examines reasonable combinations of letters until the meaningful sequence is found.

4.3.3 Stages of Problem Solving

Gestalt psychologists suggest that problem solving behaviour also follows the stages that are followed in creative thinking: preparation, incubation, illumination or insight and verification. These stages have already been discussed in the earlier section.

According to Polya , there are four stages involved in problem solving and these are as given below

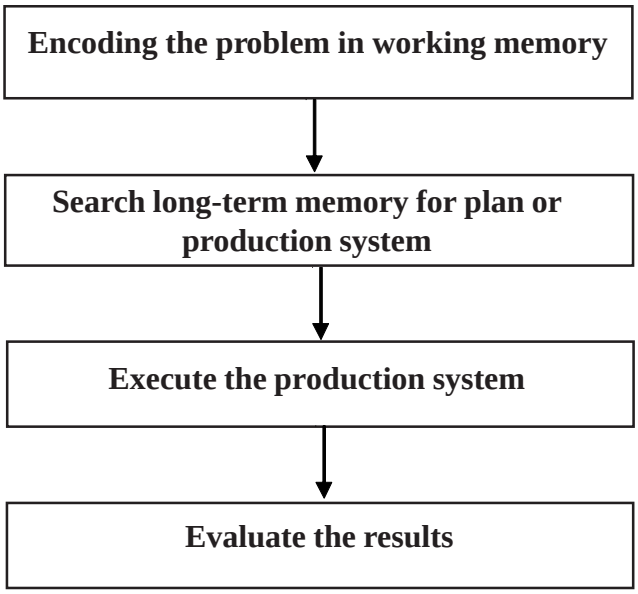
Stage 1: Define, understand and think about the problem. In this stage, there is identification of the actual problem, attributes of the problem, area of knowledge involved in solving the problem and collecting relevant information.

Stage 2: Devise a plan for solution. This stage includes thinking of alternate ways to solve the problem and preparing a flowchart of solution.

Stage 3: Carry out the plan. This stage of problem solving is to execute the solution of the problem.

Stage 4: Looking back. This involves verifying that the problem solved was the one originally defined, and also checking reasonableness, criteria and constraints as well as communicate results.

An information processing translation of the Polya's stages has also been described which is presented in the following model: (See figure below)


Encoding the problem in working memory
Search long-term memory for plan or production system
Execute the production system
Evaluate the results

4.3.4 Strategies of Problem Solving

Even if the operator has all the basic knowledge and background skills, yet there is no guarantee that they will solve the problem successfully.

In order to be successful in solving a problem, an additional element needed is to have a general strategy that can be used for problem solving.

A strategy is a set of sequential steps (or procedure) used by a problem solver in arriving at a solution. The strategy should help the operator by guiding him/her to efficiently extract relevant data from the problem space and by giving a planned approach to solving the problem. Cognitive psychologists have described two major types of strategies generally used by an operator and these are termed as algorithms and heuristics. Let us see what these are:

4.3.4.1 Algorithms

An algorithm is a strategy that ensures the correct solution of the problem, if the well-defined rule of the solution is properly followed. In an anagram problem, an algorithm would be attempting all the possible letter sequences until the correct and meaningful word is found. There are four essential properties of an algorithm:

1) Each step of an algorithm must be exact. An algorithm must be precisely and unambiguously described, so that there remains no uncertainty.
2) An algorithm must terminate. The ultimate purpose of an algorithm is to solve a problem. If the process does not stop when executed, one will not be able to get any result from it. Therefore, an algorithm must contain a finite number of steps in its execution.
3) An algorithm must be effective. It must provide the correct answer to the problem.
4) An algorithm must be general. This means that it must solve every instance of the problem. For example, a program that computes the area of a rectangle should work on all possible dimensions of the rectangle, within the limits of the programming language and the machine.

Although algorithm is a guarantee to reach to the solution, the effort and time involved in using it is so great that a human operator rarely uses this strategy.

4.3.4.2 Heuristics

Heuristics are general suggestions or “rules of thumb” that are useful in solving a variety of problems. Heuristics are powerful and general. They do not ensure a correct solution to the problem. That is why there are so many of them and if one does not work, another may be tried upon. General heuristics are usually context free and apply across many different situations. Specific heuristics are used in specialised areas, like applying the conservation of momentum principle to solve collision problems in physics, or telling students to check the units, neglect small terms, or use crude approximations.

Means-end analysis

Probably the most common and general heuristic is the ‘means-end analysis’. Simply stated, this heuristic says to do something to get a little closer to the goal. This heuristic helps break down a problem into pieces. For example, the ultimate

goal is taken in short term goals and each of these short term goals will have to be achieved and doing so helps the person to get closer to the goal and ultimately reach it.

If a large problem is broken down into pieces, it is important to self monitor the sub goals, that is whether the person has achieved it or not. This self-monitoring is known as meta-cognition. Meta-cognition is essential for any extended activity, especially problem solving, because the problem solver needs to be aware of the current activity, of the overall goal, the strategies used to attain the goal and the effectiveness of those strategies.

Working backward

This strategy starts with the goal state and the operator moves backward toward the initial state. This strategy is found to be very useful in solving problems like paper-pencil maze. Sometimes the problem solver uses this method by combining it with the means end analysis. However, working backward is useful only when the end state is uniquely well defined with an unclear initial state.

Analogies

Heuristic of analogy uses experiences of strategies used to solve past problems in solving a current problem. This strategy relies on discovering common attributes among various problems solved at previous occasions and the problem being faced presently.

4.3.5 Factors Affecting Problem Solving

Effectiveness of a problem solving behaviour is measured on two criteria: time taken in solving the problem and probability of getting the solution. An effective solution of a problem is dependent upon a number of factors. Some of these factors are inherent in the problem itself, while others belong to the personal characteristics of the problem solver. These include (i) Nature of the problem (ii) Degree of difference between the initial and the goal state (iii) The perceiver's set (iv) functional fixedness. These are being discussed below:

i) Nature of the problem

What is themagnitude of the problem, the difficulty level of the problem etc. are part of nature of the problem. Also if the initial state of the problem is too different from that of the final goal of the problem the difficulty level increases and solving the problem becomes somewhat difficult. While size of a problem is positively related with the number of elements present in the problem space, it is observed that as the size of the problem increases, it becomes all themore difficult to reach solution to the problem and also it becomes more time consuming. An example is the typical anagram problems, where an increase in the number of letters of the anagrams enhances the difficulty level of the problem.

ii) Greater the difference between initial and goal states decreases the likelihood of solution. In such situations problem space is more disorganised and therefore, the operator is required to take more steps to reach to the solution. To give an example, take a complete jumble of letters in an anagram which clearly describes such a situation.

If the problem is a general one which is frequently encountered, the problem solver becomes familiar with the steps to be followed to reach the solution and therefore, the problem becomes less difficult.

iii) The perceiver's Set is defined as a tendency to perceive and respond to a particular stimulus in a stereotypical manner. Set is formed in a situation where a person successively and systematically perceives and responds to a stimulus in a similar way. Set may prove to have facilitatory, as well as inhibitory impact on problem solving.

If the past experience paved the way to the formation of certain mental set, then the solution will become easier. But in case of greater difference among the experiences, the mental set would hinder finding solution to the problem. An example of the effect of set may be observed by pronouncing the following words:

MACDONALD MACMOHAN MACGREGOR MACHINERY

If you pronounced the last word as MacHinery, the effect of set worked on you. However, the effect of set can be minimized by increasing time interval between practice and trial, by explicit instruction to not follow the previously learned rules and by introducing some exceptions in the practice.

iv) Functional fixedness: Generally we categorise objects on the basis of their use in our daily life. Whenever we think of those objects their functional features dominate our thought process. Functional fixedness refers to the tendency to perceive the objects with their customary and stereotypical use.

In a broader sense, functional fixedness is also an example of mental set, which hinders the probability to achieve solution.

Self Assessment Questions

1) Define the problem solving behaviour.

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2) Describe the terms related to problem solving.

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3) Explain the various types of problems.

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4) Give an account of the strategies used in problem solving.

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5) Describe the factors affecting problem solving.

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4.4 LET US SUM UP

Creativity is defined as a goal directed thinking which is unusual, novel and useful. Such a thought process rejects the previously accepted ideas and organises the unclear situation in new and coherent way. Investment theory states that creativity requires a confluence of six distinct but interrelated resources: intellectual abilities, knowledge, styles of thinking, personality, motivation, and environment. Divergent thinking is thought to be a central component in any type of creative thinking. Other aspects of creative thinking are: fluency, flexibility, originality, elaboration, abstraction and resistance to premature closure. Creativity follows a four step process consisting of preparation, incubation, illumination and verification. Although creativity requires a minimum IQ of 120, but beyond that level relationship between intelligence and creativity is either not clear or is very weak. Most of the tests of creativity intend to measure divergent thinking. Such a widely used test is TTCT which includes both verbal and figural items.

Problem solving is another kind of directed thinking that begins with an obstacle or a difference between initial state and the goal state. The person is required to reorganise the problem situation to remove the obstacle and convert the problem state into then goal state. A successful understanding of problem space requires coherence, correspondence and relationship to background knowledge. Types of

problems referred in the psychological researches are well-defined and ill-defined problems, problems of inducing structure, transformation and arrangement. Cognitive psychologists have described two major types of strategies used in problem solving: algorithms and heuristics. The factors affecting the success of problem solving behaviour include the size of the problem, difference between problem state and goal state, generality of tje problem and set and functional fixedness of the problem solver.

4.5 UNIT END QUESTIONS

1) Define the process of creativity and describe that how different psychologists differ in understanding creativity.
2) Explain that how Investment and Confluence Theory of approaches creativity and present an account of aspects of creative thinking.
3) Briefly discuss the stages of creativity.
4) Describe that how creativity is related with intelligence and explain the threshold hypothesis in this regard.
5) Give an account of measurement of creativity.
6) Define the problem solving behaviour and describe the terms related to problem solving.
7) Explain the various types of problems and present an account of the strategies used in problem solving.
8) Describe the factors affecting problem solving.

4.6 GLOSSARY

Creativity : Creativity is a goal directed thinking which is unusual, novel and useful.

Historical creativity : Historical creativity is a creative thinking that becomes so important that it influence the whole human civilisation.

Investment theory : Investment theory states that creativity requires a confluence of six distinct but interrelated resources: intellectual abilities, knowledge, styles of thinking, personality, motivation, and environment.

Threshold hypothesis : The hypothesis that state that a minimal level of IQ, often arbitrary set to 120 should be necessary, but not sufficient for creativity.

Problem solving : The directed thought process involved in a person's effort to remove obstacles in the way to achieve the goal state is called problem solving.

Well-defined and ill-defined problems : A problem is well-defined if there is a definable initial state and a goal state, the number of operators is definite and they all are well identified and there are quite explicit rules and

sub-goals to convert the initial state into the goal state. On the contrary, in case of ill-defined problem one or all of the elements of the problem space (initial state, goal state, operators and rules) are not clearly defined.

Problems of inducing structure : Problems of inducing structure require determining relationship among several elements of the problem.

Problems of transformation : Problems of transformation require finding a sequence of operations to transform the initial state into the goal state.

Problems of arrangement : Problems of arrangement requires the operator to rearrange the elements of the problem according to some criterion.

Strategy of problem solving : A strategy is a set of sequential steps (or procedure) used by a problem solver in arriving at a solution.

Algorithm : An algorithm is a strategy that ensures the correct solution of the problem, if the well-defined rule of the solution is properly followed.

Heuristics : Heuristics are general suggestions or "rules of thumb" that are useful in solving a great variety of problems but do not ensure a correct solution to the problem.

Set : Set is defined as a tendency to perceive and respond to a particular stimulus in a stereotypical manner.

Functional fixedness : Functional fixedness refers to the tendency to perceive the objects with their customary and stereotypical use.

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